

Risk Communication: Against the Gods or Against all Odds? Problems and Prospects of Accounting for Black Swans

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Abstract

Recent academic and policy preoccupations with 'Black Swans' underscore the predicament of capturing and communicating risk events when information is absent, partial, incomplete or contingent. In this article we wish to articulate some key thematic and theoretical points of concurrence around which academic and practitioner interests in risk communication under conditions of 'high uncertainty' intersect. We outline the historical context and recent debate concerning the limits to 'risk thinking' spurred by Black Swans, and in particular how this calls for a more holistic approach to risk communication. In order to support a more critical foresight agenda, we suggest incorporating 'adaptive governance' principles to decenter focal risk communication concerns on the mitigation of short-term security threats, which critics argue can also lead to other unforeseen dangers. Finally, we welcome further interdisciplinary inquiry into the constitution and use of risk communication under high uncertainty.

Keywords: Black Swans; High uncertainty; Risk Communication; Adaptive governance; Sustainability

When resources are plentiful one can always hope, rightly or wrongly, to stay 'on top of' or 'ahead of' things, to be able to catch up with the fast-moving targets; one might then be inclined to play down the risks and insecurity and assume that the profusion of choices compensates many times over for the discomforts of living in the dark, of never being sure when and where the struggle ends or whether it has an end at all.

Zygmunt Bauman (2000), *Liquid Modernity*, P88

1. Introduction

Indeterminacy about future harm is an age-old concern, but recently the manifestation of highly uncertain threats in the form of 'Black Swans' (Taleb 2007) has led to calls for a critical re-appraisal of the application and capacities of risk-based approaches to assess and manage future harms. This article aims to contribute to on-going academic and policy debate on the problems and prospects of dealing with Black Swans by paying especial attention to the related issues and difficulties surrounding risk communication under conditions of high uncertainty and how they might be overcome. In particular, we reflect on how a holistic approach to risk communication, underpinned by principles of 'adaptive governance' may help to move considerations forward to support the adoption of a more critical foresight agenda.

The article is organized into four main thematic sections and a conclusion. First, we outline some key historical developments in risk thinking and practice in relation to uncertainty that serve to prefigure current institutional responses to future threats. Next, we consider the relatively recent emergence of Taleb's (2007) Black Swan thesis along with other forms of 'high uncertainty' popularized through vernacular such as 'unknown unknowns'. We then identify how Black Swans prompt important consideration of the use and value of risk-based conventions, and how this focal preoccupation has subsequently led to a renewed emphasis on mechanisms orientated towards anticipation and foresight. In view of difficulties resulting from 'anticipatory solutions' to 'foresighted problems', we point to the need for a more holistic approach to help decenter the current focus on short-term security outcomes common to uncritical responses to Black Swans. Subsequently, we suggest that a more holistic formulation of risk communication according with 'adaptive governance' principles would help to critically expand the scope, logics and capacities of organized risk responses when confronting high uncertainty. In conclusion, we welcome further critical and interdisciplinary inquiry into Black Swans to help support these objectives.

2. Against the Gods: The emergence of risk thinking

Human civilization has long had to contend with individual and collective threats to survival arising from an uncertain, complex and ever-changing environment (Plough and Krinsky 1987). Historically speaking, people's expectations and experiential understandings of uncertainty surrounding the occurrence of adverse eventualities has owed much to concepts such as 'fate', 'chance' and 'the hands of the Gods' (see Bernstein 1996; Giddens 1999). In such terms, all manner and varieties of harm and loss could be taken at face value as people seemingly had little choice but to live in the hope it was fortune smiling on them and not the sword of Damocles hanging over them (Klinke and Renn 2002). Being resilient in the face of uncertainty thus meant not only dealing with adverse eventualities as they arose, but also accepting that one had little choice in such matters.

Historians and sociologists note that the emergence of 'risk' thinking into this context consequently provided a powerful new lens through which to re-orientate thinking about the future (Bernstein 1998; Hacking 1990). According to Rose (1999) the key innovation of risk lay in its affordance for making intelligible a series of problems of contemporary existence by bringing the future into the present and ostensibly making uncertain eventualities calculable. For Knight (1924), the measurability of risk in particular marked it out as conceptually distinct from uncertainty, for which quantities were assumed not to be susceptible to measurement. According to this view, risk refers to a situation of perfect knowledge whereby all the possible probabilities and outcomes are known and in which there is a 'correct' or 'optimal' answer, whereas in cases of uncertainty all the probabilities are unknown or unknowable (Volz and Gigerenzer 2013). In economic terms, the incorporation of constructs such as 'probability' and 'expected value' into risk measurement provided decision makers with a scientific calculus for being 'rationally' concerned about some potential eventualities and choosing to ignore others (Aven and Renn 2009). This meant that probable outcomes arising from potential eventualities could be determined, and fortune or loss could be assigned to deliberate choices from a range of possible options (Bernstein 1998; Rosa 1998). Reasonable attempts could accordingly be made to engage in actions that might enhance profit, but also to help to mitigate or offset the downsides of any potential choices where the costs were manageable and the upsides provided insufficient potential rewards in and of themselves (Ewald 1991).

The conceptual innovations brought about by risk thinking proved to be immensely successful for protecting beneficial activities in the face of routine risks and improbable disasters (Bernstein 1998). Subsequently, the logics and practices of risk assessment and management rapidly spread. Moreover, the language and scope of risk markedly expanded into many domains as new means and forms of risk related information collection, measurement and application were necessitated or arose (Mythen 2014b; Rose 1996). Notwithstanding the importance of the fundamental distinctions between risk and uncertainty specified above, in everyday life and working practices, risk related decisions are rarely made with perfect knowledge. Rather, it is customary to not know all of the possibilities, alternatives, probabilities and consequences (Volz and

Gigerenzer 2013). So, while in principle uncertainty may be reduced through seeking more information (van Asselt and Vos 2006), in practice decision-makers assess risk under conditions that are inherently uncertain, except in highly prescribed contexts.

Nowadays, preoccupation with risk is commonplace. The use of risk related tools and practices has accelerated at pace over the past forty years or so colonizing activities across individual, social and institutional domains in areas as varied as food safety, technology, business, the environment, criminal justice, education and welfare (Beck 1992; Renn 1998; Rothstein, Huber and Gaskell 2006; Mythen, 2014b). Most risk-based policies and practices also typically accord with a view that scientific progress is often driven by a need to understand uncertainty, and that scientific inquiry can reveal new uncertainties needing to be addressed (Pidgeon and Fischhoff 2011). Therefore, instead of employing absolute distinctions, risk is perhaps best conceived as a relational construct that is intermingled with uncertainty (van Asselt and Vos 2006). In these terms, risk may be broadly defined as an uncertain threat posed by an activity or event with respect to something that humans value (Boholm and Corvellec 2011). Following this cognitive framing of risk, the introduction or use of risk logics and practices can be considered as an interpretative process that brings fluidity into ostensibly 'solid' categories of existence that have otherwise previously established meaningful distinctions and experiential encounters of uncertainty and harm (Bauman 2000; 2007).

Identifying and dealing with risk in its varied modes has become central to contemporary forms of organizing and social ordering (Beck 1992; Power 2007; Hardy and Maguire 2016). How people differentially perceive, evaluate and respond to risk has therefore also been accounted for by developments in measuring individual and cultural attitudes and observed behaviours (Slovic et al. 2004). This additional form of risk measurement has made it possible to ascertain who is considered to be risk seeking, who is considered to be risk averse, and how this varies with respect to different types of appraisal and levels of benefit, harm and uncertainty across different contexts and cultures (Kahneman, Slovic and Tversky 1982; Slovic et al. 2004; Wright and Philips 1980). Armed with such information it is theoretically possible to determine not only behavioral tendencies of populations and sub-populations, but also to specify socially acceptable levels of risk beyond purely scientific and economic considerations of 'how safe is safe enough' (Fischhoff et al. 1978; Renn 1998). Risk communication, by extension, is now widely acknowledged to play a vital role in these processes, not only as an informational tool by which to gather, learn and share information, but also as the primary means by which organized responses to risk are constituted across locations in different relational forms (Wardman 2008). Knowing information that is predictive of risks and how people appraise and respond to risk in light of such preferences together provides a vital apparatus for planning future action, managing and responding to risk events as they unfold, and introducing or reinforcing regulations and procedures to improve safety and risk related conduct (Burns and Slovic 2012; Lemke 2001; Mythen 2014a; Rose 1999).

3. Against the odds: the emergence of Black Swans

All of the above defines the contours and parameters under which contemporary decisions making around risk communication and management take place, both at an individual and an institutional level. Yet, in the course of the twenty-first century, a range of high profile global incidents - among them 9/11, the devastating earthquake in Kashmir, the Aceh tsunami and the Fukushima nuclear disaster - have become emblematic of the limits of predictive tools of risk management, prompting risk managers to reconsider how to identify, characterize and act on uncertainty. Taleb (2007) famously refers to the manifestation of these rare and unpredictable occurrences as 'Black Swans'. Others have dubbed such happenings 'tail end risks', 'deep uncertainties', 'uncertain risks', and 'post-normal risks' (Aven 2013; Cox 2012; McCulloch and Pickering, 2010; Mythen and Walklate, 2010; Rosa 1998; van Asselt and Vos 2008).

Following Taleb (2007), Black Swans are typically characterized as novel or surprising risk events with major impacts that no one thought would happen beforehand and afterwards challenge pre-conceived assumptions. That is, with the benefit of hindsight it is thought that these 'outlying' risk events could have been better predicted and accounted for despite their occurrence or impacts seemingly being indeterminate at the time (see also Aven 2015, for a delineation of types of Black Swan). In popular terms, concern about the problem of high uncertainty for risk management has also been encapsulated by the United States Secretary of Defense Donald Rumsfeld's (2002) infamous response to the lack of evidence linking the Iraq government to the supply of weapons of mass destruction to terrorist groups:

Reports that say that something hasn't happened are always interesting to me, because as we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know. And if one looks throughout the history of our country and other free countries, it is the latter category that tend to be the difficult ones.

Although much maligned, this remark on the difficulties presented by 'unknown unknowns' clearly chimes with Taleb's (2007) critique both that high uncertainty can confound conventional risk assessment procedures, and that presumptions of certainty ostensibly arising from decisions based on probabilistic assessments may prove to be a recipe for disaster. Together with the social explosion of risk images and concerns perpetuated by the media (Beck 1995), situations of high uncertainty have understandably been held up to shine a spotlight on the limits of institutional capabilities to foresee hazards and pre-emptively intervene in disasters (Mythen 2014a). There is now a growing acceptance that, because risk is embedded in larger contexts of social and organizational relations and processes, many problems cannot always be controlled or fully accounted for following the 'routine' conventions and

practices of risk-based approaches and more can and ought to be done (Aven 2013; Aven 2015; Cox 2013; Kline and Renn 2002; Mythen 2014a).

Consequently, over the last decade - and partly as a response to failures in risk assessment and intelligence gathering - regulatory institutions have become engrossed in numerous attempts to better account for highly uncertain eventualities (Brown and Olofsson 2014). Such foresight initiatives typically involve the development of scenarios to anticipate and examine in advance the prospects and likely implications of a hypothetical event and its outcomes. More broadly speaking, future orientated methodologies might also incorporate tools and techniques of visioning, forecasting, visualization, and plan-making in order to address the question 'what if?' and lay the grounds for anticipating and reacting to different events should they occur (Freestone 2012). The use of such methods is notably observed in the field of counter-terrorism and national security (Walklate and Mythen 2015; Mythen and Walklate 2008; Stern and Weiner 2006), but is also increasingly apparent in relation to natural, health and technological hazards as observed through responses to indeterminacy about the causes and effects surrounding the cases of global warming, flooding, pandemic infectious disease outbreaks, and nuclear accidents (Barbi and Ferreira 2014; Figuié 2014; Pate-Cornell 2012). Additionally, political drives towards greater institutional transparency have led to calls for all uncertainties associated with risk assessment to be publicly disclosed (Lofstedt and Wardman 2016). As such, the staging and communication of uncertainty is increasingly becoming part and parcel of the contemporary risk landscape (Beck 2009), with activities ranging from training drills to evaluate preparedness for CBRNE attacks, to politicians hypothesizing about the nature of upcoming threats to the nation from terrorist cells, and the disclosure of incertitude surrounding the assessment of these and many other risks.

4. Hindsight does not equal foresight

Insofar as risk practitioners and academics are understood to be routinely pre-occupied with uncertainty related problems in various guises, the concept of Black Swans might seemingly appear to add merely another flavor to the wide variety and types of uncertainty that already befuddle regulatory institutions (Arvai 2014; Kasperson 2014; Pidgeon 2014; McCommas 2014). However, as critics have recently pointed out, a deep-seated problem confronting institutions is that they typically lack fundamental strategic capacity not only in uncertainty assessment, but also appropriate risk communication methods for situating values in public engagement or fostering citizen deliberation for the wider public good (Kasperson 2014; Pidgeon and Fischhoff 2011; Pidgeon 2014). Therefore, attending to high uncertainty has proven notably problematic to risk-based approaches for a host of reasons, which not only exacerbate current problems and stretch current capabilities, but can also introduce new concerns and dilemmas.

To illustrate the point from a 'risk assessment' perspective, the occurrence of uncertain risk events, which is to say Black Swans, may be considered so rare, or the consequences so unthinkable, that there is insufficient

basis for identification or measurement that would otherwise allow the prediction of losses and avert accidents or catastrophes (Pate-Cornell 2012). Attempts to assess the risk of Black Swans might not therefore so easily employ the traditional tools and techniques that are conventionally associated with rational evidence-based approaches to identifying and managing risk. The associated worry is that without the 'decision-analytic' rigor conferred by risk-based thinking, regulatory focus on Black Swans may become undisciplined and susceptible to the biases or paradoxical thinking leveled at the use of pre-emptive approaches to risk. Particularly, a preponderance on 'worst case' scenarios seemingly common to the focus of Black Swan narratives can introduce unforeseen dangers and costs (Walklate and Mythen, 2015; Stern and Weiner 2006). At the same time, institutions need to remain alert, quickly detect risks as they arise, and provide the earliest possible response (Pate-Cornell 2012).

From a 'risk communication' perspective, while best practice guidance is replete with advice that uncertainty should in principle always be acknowledged, many longstanding questions abound concerning how best to incorporate uncertainty into risk communication in practice. These questions include: 'what' uncertainties to communicate; 'which' format to use; 'when' to communicate uncertainty; 'whom' to involve; and to 'what ends'? Despite the importance of these questions, empirical research has not yet provided declarative support for the efficacy of uncertainty communication guidance or how best to proceed. To wit, while making the full catalogue of uncertainty information available can be informative and useful to some stakeholders, there are general reservations that for others it might not be required, can be confusing, contribute to 'information fatigue', or bring about behavioural changes that cause more harm than good (Fischhoff 2013; Kasperson 2014; Wardman and Lofstedt 2009). A further worry is that if people are overwhelmed, or feel the communication of high uncertainty is unwarranted, that this can also lead to accusations that risk managers are intentionally obfuscating 'real' risk concerns (Fischhoff 1995). At the same time, foreclosing opportunities for communication might send a message that those same risk managers think others cannot be trusted with such information, or thought not worth talking to (Fischhoff 1995). This can in turn prove alienating and confirm suspicions of political and managerial irresponsibility, leading to a further erosion of trust in regulatory institutions and other organizations (Leiss 1996; Lofstedt 2005).

While few would argue that encouraging reflection on safety and promoting preparedness is a bad thing, in certain areas of risk regulation, such as counter-terrorism, the disentangling of tangible facts and probabilities from hypothetical worst-case imaginations has served to muddy the waters between what is possible and what is probable. Within this, the envisaging and pre-mediation of particular types of attack, both politically and in the mass media, produces impacts on people's consciousness and informs public perceptions of danger. Pre-mediations act as harbingers of harm that do not so much present what *has* happened, but foster speculation about what *may* happen next. Building on Baudrillard's 1984 work, we can caution against situations of *hyper-riskality*, in which the imagined risks begin to take on greater resonance than those which appear to be tangible and estimable (see Mythen and Walklate,

2010). In such a febrile climate, pre-emptive interventions are not so much encouraged, as demanded. Responsibility for guarding against future harms very much depends on assertive action in the present (Amoore, 2007). Yet problems arise when dystopic future occurrences - however statistically remote - are acted on as if they were likely possibilities (see Amoore, 2013: 1). Dick Cheney's infamous 'one percent doctrine', where only a hundredth of a fraction of a risk to national security should propel concerted action is an apt illustration of this kind of pre-emptive delirium (see Suskind 2007). As Hudson (2013, 9) observes, 'unlike the normal logic of risk management, precautionary logic does not entail actuarial calculations of the disastrous event occurring, its mere possibility is sufficient to bring forth preventive actions'.

Opinion is plainly divided on how to conceive and implement anticipatory approaches to high uncertainty in practice (see for example controversy over the use of the 'precautionary principle': Aven 2011; Lofstedt 2014). Yet, if an underlying point can be taken from the disruption posed by the focal preoccupation with Black Swans to institutional risk thinking and practices, it is perhaps that, without due care, decisions under high uncertainty will continue to be punctured by political bias and filtered through sociocultural values and expectations (Dietz 2013; Slovic 1993; Slovic 1999; Wardman 2014). The uncritical use of foresighted risk interventions will accordingly boil down to questions of democratic accountability and where the power lies, as much as how 'best' to effectively assess, represent, communicate and learn from events characterized by partial, incomplete, and contingent information. In the event, information about some uncertain eventualities may not or may not be shared, such as for security reasons, and the reasons for doing so may not be wholly clear or consistent (Wardman 2008). Critical inquiry is plainly needed to redress these imbalances.

5. Accounting for that which can't be counted: Sustaining a critical foresight agenda

There are no easy answers to the problems and dilemmas highlighted above, but clearly an uncritical emphasis on high uncertainty can be potentially detrimental to goals of allocating risk management attention and resources in the most effective and efficient ways. Reconciling concerns about such issues as the costs, benefits and countervailing risks of addressing Black Swans therefore requires adopting a more expansive and critical 'foresight' agenda. One pragmatic response is that high uncertainty accordingly calls for risk-based approaches to become more integrative, adaptive and process driven (Aven 2013; Cox 2012; Klinke and Renn 2012). In this view, rather than focusing on short term security concerns, the identification and risk management of Black Swan events is considered to evolve over time and incorporate new information from a range of different perspectives as it comes to light in a manner that is also reflective of sociocultural and political values.

The formalization of pluralistic rationales and methodologies to help address the limits of conventional 'evidence based' approaches and incorporate

alternative views has been developed previously in epistemologically orientated frameworks (e.g. Rosa 1998; Klinke and Renn 2002). For example, Klinke and Renn (2012) specify that adaptive and integrative approaches should ideally incorporate the following attributes:

- Embody a dynamic process of continuous and gradual learning
- Be guided by the inclusion of different values and frames of reference
- Screen for risk related features through 'pre-estimation'
- Conduct interdisciplinary risk and concern assessments incorporating natural/technical science and social science perspectives
- Evaluate limits of knowledge and find 'common ground' to resolve ambiguities and complexities
- Make the selection and implementation of policies subject to on-going monitoring and adjustment to calibrate responses

One key implication for practitioners arising from incorporating an adaptive perspective is that generating prescriptive step-by-step risk communication plans, or adopting static standardized best practice guidance specifying 'exactly what to do' in response to Black Swan events may in fact be counterproductive. As Coombs (2013) observes, unknown-unknowns are, by definition, unknowable, and, given that even 'known knowns' don't always pan out according to plan, it is better to focus attention on the process of dealing with novel events. This requires emphasis on having knowledge and skills that can be applied flexibly when reacting to the moment rather than setting prescribed actions. Coombs (2013) suggests, for example, that preparations for communicative responses within organizations should accordingly focus on developing collective working practices and honing communication skills that can be adapted to whatever crisis takes place. Organizations that involve regular dialogue with stakeholders when developing and maintaining their foresight policies are also thought to be better positioned to anticipate and build capacities to react to Black Swan events as they arise (Aven 2013; 2015). Establishing good relations with stakeholders can also foster greater co-operation making operational responses to Black Swans less vulnerable to conflict, as well as help to meet and manage expectations for greater transparency and honesty (Coombs 2013).

For researchers, it is also commonly understood that, while efforts are often made to limit mistakes and oversights, post hoc critical analysis must take place and lessons need to be learned when risk management goes awry (Fischhoff 1995). Studies may aim to provide a means to calibrate whether institutions turn out to be over confident or under confident in their predictions. Research inquiry may also be targeted to understand how ostensibly 'unknown unknowns' become normalised as knowable risks to be avoided or managed (Hardy and Maguire 2016).

6. Summary and Conclusions

If an underlying point can be ascertained, it is that Black Swans are not simply out there waiting to be discovered. Rather, much like other risks, Black Swans are constructs that are produced through different knowledge processes and discursive practices (Klinke and Renn 2012). Such knowledge, and how it forms a legitimate basis for action or inaction, is privileged selectively through established mechanisms that grant authority to certain agents and institutions that determine which truths are meaningful (Brown and Olofsson 2014; Hardy and Maguire 2016; Wardman 2008). We argue that the associated task is to adopt a more expansive and critical view of communicative responses to Black Swans. This has great implications for risk academics and practitioners alike. If attempts aimed to address the problem of high uncertainty are to prove more than simply haphazard and opportunistic, it is imperative that critical evaluations of high uncertainty are undertaken that take account of the social, political, ethical and material forces that delineate and shape its interpretation, uses, processes, and ultimately its consequences. Against this backdrop, it is unsurprising that scholars in the natural and social science disciplines have been actively grappling with the problem of high uncertainty and have sought to assist regulatory institutions, law enforcement agencies and the emergency response services in resilience and capability in dealing with such risks. Future opportunities for cross-disciplinary synergies and learning to address these issues and problems are to be welcomed.

References

- Amoore, L. 2007. "Vigilant Visualities: The Watchful Politics of the War on Terror." *Security Dialogue* 38 (2): 215–232.
- Amoore, L. 2013. *The Politics of Possibility*. Durham, NC: Duke University Press.
- Árvai, J. 2014. "The End of Risk Communication as We Know it." *Journal of Risk Research* 17 (10): 1245–1249.
- van Asselt, M. B. A., and E. Vos. 2006. "The Precautionary Principle and the Uncertainty Paradox." *Journal of Risk Research* 9 (4): 313–336.
- Aven, T. 2011. "On Different Types of Uncertainties in the Context of the Precautionary Principle." *Risk Analysis* 31 (10): 1515–1525.
- Aven, T. 2013. "On How to Deal with Deep Uncertainties in a Risk Assessment and Management Context." *Risk Analysis* 33 (12): 2082–2091.
- Aven, T. 2015. "Implications of Black Swans to the Foundations and Practice of Risk Assessment and Management." *Reliability Engineering & System Safety* 134: 83–91.
- Aven, T., and O. Renn. 2009. "On Risk Defined as an Event Where the Outcome is Uncertain." *Journal of Risk Research* 12 (1): 1–11.
- Barbi, F., and L. D. C. Ferreira. 2014. "Risks and Political Responses to Climate Change in Brazilian Coastal Cities." *Journal of Risk Research* 17 (4): 485–503.
- Baudrillard, J. 1994. *Simulacra and Simulation*. Ann Arbor: University of Michigan Press.
- Bauman, Z. 2000. *Liquid Modernity*. Cambridge: Polity Press.
- Bauman, Z. 2007. *Liquid Times: Living in an Age of Uncertainty*. Cambridge: Polity.
- Beck, U. 1992. *Risk Society: Towards a New Modernity*. London: Sage.
- Beck, U. 1995. *Ecological Politics in an Age of Risk*. Cambridge: Polity Press.
- Beck, U. 2009. *World at Risk*. Cambridge: Polity Press.
- Bernstein, P. L. 1996. *Against the Gods: The Remarkable Story of Risk*. New York: Wiley.
- Boholm, Å., and H. Corvellec. 2011. "A Relational Theory of Risk." *Journal of Risk Research* 14 (2): 175–190.

Brown, P. R., and A. Olofsson. 2014. "Risk, Uncertainty and Policy: Towards a Social-Dialectical Understanding." *Journal of Risk Research* 17 (4): 425–434.

Burns, W. J., and P. Slovic. 2012. "Risk Perception and Behaviors: Anticipating and Responding to Crises." *Risk Analysis* 32 (4): 579–582.

Coombs, W. T. 2013. *Applied Crisis Communication and Crisis Management: Cases and Exercises*. London: Sage.

Cox Jr, A. L. 2012. "Confronting Deep Uncertainties in Risk Analysis." *Risk Analysis* 32 (10): 1607–1629.

Dietz, T. 2013. "Bringing Values and Deliberation to Science Communication." *Proceedings of the National Academy of Sciences* 110: 14081–14087.

Ewald, F. 1991. "Insurance and Risk." In *The Foucault Effect: Studies in Governmentality*, edited by G. Burchell, C. Gordon, and P. Miller, 197–210. London: Harvester Wheatsheaf.

Figuié, M. 2014. "Towards a Global Governance of Risks: International Health Organisations and the Surveillance of Emerging Infectious Diseases." *Journal of Risk Research* 17 (4): 469–483.

Fischhoff, B. 1995. "Hindsight is Not Equal to Foresight: The Effect of Outcome Knowledge on Judgment under Uncertainty." *Journal of Experimental Psychology: Human Perception and Performance* 1 (3): 288.

Fischhoff, B. 2013. "The Sciences of Science Communication." *Proceedings of the National Academy of Sciences* 110 (Suppl. 3): 14033–14039.

Fischhoff, B., P. Slovic, S. Lichtenstein, S. Read, and B. Combs. 1978. "How Safe is Safe Enough? A Psychometric Study of Attitudes towards Technological Risks and Benefits." *Policy Sciences* 9 (2): 127–152.

Freestone, R. 2012. "Futures Thinking in Planning Education and Research." *Journal for Education in the Built Environment* 7 (1): 8–38.

Giddens, A. 1999. "Risk and Responsibility." *Modern Law Review* 62 (1): 1–10.

Hacking, I. 1990. *The Taming of Chance*. Cambridge: Cambridge University Press.

Hardy, C., and S. Maguire. 2016. "Organizing Risk: Discourse, Power, and 'Riskification'." *Academy of Management Review* 41 (1): 80–108.

Hudson, B. 2013. "Who Needs Justice? Who Needs Security?" In *Justice and Security in the 21st Century: Risks, Rights and the Rule of Law*, edited by B. Hudson and S. Ugelvik, 6–20. London: Routledge.

Kahneman, D., P. Slovic, and A. Tversky eds. 1982. *Judgment under Uncertainty*. Cambridge: Cambridge University Press.

Kasperson, R. 2014. "Four Questions for Risk Communication." *Journal of Risk Research* 17 (10): 1233–1239.

Klinke, A., and O. Renn. 2002. "A New Approach to Risk Evaluation and Management: Risk-based, Precaution-based, and Discourse-based Strategies." *Risk Analysis* 22 (6): 1071–1094.

Klinke, A., and O. Renn. 2012. "Adaptive and Integrative Governance on Risk and Uncertainty." *Journal of Risk Research* 15 (3): 273–292.

Knight, F. H. 1921. *Risk, Uncertainty and Profit*. Boston, MA: Houghton Mifflin.

Leiss, W. 1996. "Three Phases in the Evolution of Risk Communication Practice." *The Annals of the American Academy of Political and Social Science* 545: 85–94.

Lemke, T. 2001. "'The Birth of Bio-politics': Michel Foucault's Lecture at the Collège De France on Neo-liberal Governmentality." *Economy and Society* 30 (2): 190–207.

Löfstedt, R. E. 2005. *Risk Management in Post-trust Societies*. New York: Palgrave Macmillan.

Lofstedt, R. E. 2014. "A Possible Way Forward for Evidence-based and Risk-informed Policy-making in Europe: A Personal View." *Journal of Risk Research* 17 (9): 1089–1108.

Löfstedt, R. E., F. Boudier, J. Wardman, and S. Chakraborty. 2011. "The Changing Nature of Communication and Regulation of Risk in Europe." *Journal of Risk Research* 14 (4): 409–429.

Löfstedt, R. E., and J. K. Wardman. 2016. "State of the Art Transparency: Lessons from Europe and North America." *Journal of Risk Research* 19 (9): 1079–1081.

McCulloch, J., and S. Pickering. 2010. "Future Threat: Pre-Crime, State Terror, and Dystopia in the Twenty First Century." *Criminal Justice Matters* 81: 32–33.

McComas, K. A. 2014. "Perspective on 'Four Questions for Risk Communication'." *Journal of Risk Research* 17 (10): 1273–1276.

Mythen, G. 2014a. "Managing Security under Conditions of High Uncertainty: Institutional Strategies and Dilemmas." In *Safety, Reliability, Risk and Life-cycle Performance of Structures and Infrastructures*, edited by George Deodatis, Bruce R. Ellingwood, and Dan M. Frangopol, 149–156. Boca Raton, FL: CRC Press.

Mythen, G. 2014b. *Understanding the Risk Society: Crime, Security and Justice*. London: Palgrave Macmillan.

Mythen, G., and S. Walklate. 2008. "Terrorism, Risk and International Security: The Perils of Asking 'What If?'" *Security Dialogue* 39 (2-3): 221-242.

Mythen, G., and S. Walklate. 2010. "Pre-crime, Regulation and Counter-terrorism: Interrogating Anticipatory Risk." *Criminal Justice Matters* 81 (1): 34-36.

Paté-Cornell, Elisabeth. 2012. "On 'Black Swans' and 'Perfect Storms': Risk Analysis and Management When Statistics are Not Enough." *Risk Analysis* 32 (11): 1823-1833.

Pidgeon, N. 2014. "Complexity, Uncertainty and Future Risks." *Journal of Risk Research* 17 (10): 1269-1271.

Pidgeon, N., and B. Fischhoff. 2011. "The Role of Social and Decision Sciences in Communicating Uncertain Climate Risks." *Nature Climate Change* 1 (1): 35-41.

Plough, Alonzo, and Sheldon Krinsky. 1987. "The Emergence of Risk Communication Studies: Social and Political Context." *Science, Technology, & Human Values* 12 (3/4): 4-10.

Power, M. 2007. *Organized Uncertainty: Designing a World of Risk Management*. Oxford: University of Oxford.

Renn, O. 1998. "Three Decades of Risk Research: Accomplishments and New Challenges." *Journal of Risk Research* 1 (1): 49-71.

Rosa, E. A. 1998. "Metatheoretical Foundations for Post-normal Risk." *Journal of Risk Research* 1 (1): 15-44.

Rose, N. 1999. *Powers of Freedom: Reframing Political Thought*. Cambridge: Cambridge University Press.

Rothstein, Henry, Michael Huber, and George Gaskell. 2006. "A Theory of Risk Colonization: The Spiralling Regulatory Logics of Societal and Institutional Risk." *Economy and Society* 35 (1): 91-112.

Rumsfeld, Donald. 2002. "Department of Defense News Briefing." US Department of Defense, February 12. <http://archive.defense.gov/Transcripts/Transcript.aspx?TranscriptID=2636>.

Slovic, P. 1993. "Perceived Risk, Trust, and Democracy." *Risk Analysis* 13 (6): 675-682.

Slovic, P. 1999. "Trust, Emotion, Sex, Politics, and Science: Surveying the Risk-Assessment Battlefield." *Risk Analysis* 19 (4): 689-701.

Slovic, P., M. L. Finucane, E. Peters, and D. G. MacGregor. 2004. "Risk as Analysis and Risk as Feelings: Some Thoughts about Affect, Reason, Risk, and Rationality." *Risk Analysis* 24 (2): 311-322.

Stern, J., and J. B. Wiener. 2006. "Precaution against Terrorism." *Journal of Risk Research* 9 (4): 393-447.

Suskind, R. 2007. *The One Percent Doctrine: Deep inside America's Pursuit of Its Enemies since 9/11*. New York: Simon and Schuster.

Taleb, Nassim Nicholas. 2007. *The Black Swan: The Impact of the Highly Improbable*. London: Penguin Books.

Van Asselt, M. B., and E. Vos. 2008. "Wrestling with Uncertain Risks: EU Regulation of GMOs and the Uncertainty Paradox." *Journal of Risk Research* 11 (1): 281-300.

Volz, K. G. and Gigerenzer, G. 2012. "Cognitive Processes in Decisions Under Risk are not the Same as in Decisions Under Uncertainty." *Frontiers in Neuroscience* 6: 105.

Walklate, S., and G. Mythen. 2015. *Contradictions of Terrorism*. London: Routledge.

Wardman, J. K. 2008. "The Constitution of Risk Communication in Advanced Liberal Societies." *Risk Analysis* 28 (6): 1619-1637.

Wardman, J. K. 2014. "Sociocultural Vectors of Effective Risk Communication." *Journal of Risk Research* 17 (10): 1251-1257.

Wardman, J. K., and R. Lofstedt. 2009. *European Food Safety Authority-Risk Communication Annual Review*. Parma: European Safety Authority.

Wright, G. N., and L. D. Phillips. 1980. "Cultural Variation in Probabilistic Thinking: Alternative Ways of Dealing with Uncertainty." *International Journal of Psychology* 15 (1-4): 239-257.